PB-239 588

RANGELEY LAKE, FRANKLIN COUNTY, MAINE

Pacific Northwest Environmental
Research Laboratory

Prepared for:

National Environmental Research Center
Maine National Guard
Maine Department of Environmental
Protection

May 1974

DISTRIBUTED BY:

NTIS
National Technical Information Service
U. S. DEPARTMENT OF COMMERCE

TECHNICAL REPORT DATA (Please read Instructions on the reverse before completing)		
1. REPORT NO.	2.	3. PB 239 588
4. TITLE AND SUBTITLE Report on Rangeley Lake, Franklin Coutny, Maine		5. REPORT DATE May 1974 6. PERFORMING ORGANIZATION CODE
7. AUTHOR(S) Anonymous (National Eutrophication Survey Staff)		8. PERFORMING ORGANIZATION REPORT NO. Working Paper # 6
9. PERFORMING ORGANIZATION NAME AND ADDRESS Pacific Northwest Environmental Research Laboratory U.S.Environmental Protection Agency 200 S. W. 35th St. Corvallis, Oregon 97330		10. PROGRAM ELEMENT NO. 1BA029 11. CONTRACT/GRANT NO.
12. SPONSORING AGENCY NAME AND ADDRESS U.S. Environmental Protection Agency		13. TYPE OF REPORT AND PERIOD COVERED Final - 1972 14. SPONSORING AGENCY CODE

15. SUPPLEMENTARY NOTES

Prepared in cooperation with the U.S. Environmental Protection Agency, National Environmental Research Center, Las Vegas, Nevada 89114

16. ABSTRACT

Annual total phosphorus and total nitrogen loadings to the lake were estimated and subdivded according to either point or non-point source origin. An assessment of the lake's trophic condition and limiting nutrient is also provided. All data collected by the U.S.E.P.A. National Eutrophication Survey during the one year study of the lake and its tributaries are included in the report.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
eutrophication lakes nutrients phosphorus nitrogen loading		05B 05C

Reproduced by
NATIONAL TECHNICAL
INFORMATION SERVICE
US Department of Commerce
Springfield, VA. 22151

18. DISTRIBUTION STATEMENT	19. SECURITY CLASS (This Report)	21. NO. OF PAGES
Release unlimited		41
	20. SECURITY CLASS (This page)	22. PRICE 3.75

PRICES SUBJECT TO CHANGE

REPORT
ON
RANGELEY LAKE
FRANKLIN COUNTY
MAINE

EPA REGION I

WORKING PAPER No. 6

WITH THE COOPERATION OF THE

MAINE DEPARTMENT OF ENVIRONMENTAL PROTECTION

AND THE

MAINE NATIONAL GUARD

MAY, 1974

CONTENTS

	Page
Foreward	ii
List of Maine Study Lakes	iv
Lake and Drainage Area Map	v
Sections	
I. Conclusions	1
II. Introduction	2
III. Lake and Drainage Basin Characteristics	3
IV. Lake Water Quality Summary	4
V. Nutrient Loadings	8
VI. Literature Reviewed	15
VII. Appendices	16

FOREWORD

The National Eutrophication Survey was initiated in 1972 as a research project in response to an Administration commitment to investigate the nationwide threat of accelerated eutrophication to fresh water lakes and reservoirs.

OBJECTIVES

The Survey was designed to develop, in conjunction with state environmental agencies, information on nutrient sources, concentrations and impact on selected fresh water lakes as a basis for formulating comprehensive and coordinated national, regional and state management practices relating to point-source discharge reduction and non-point source pollution abatement in lake watersheds.

ANALYTIC APPROACH

The mathematical and statistical procedures selected for the Survey's eutrophication analysis are based on related concepts that:

a. A generalized representation or model relating sources, concentrations and impacts can, in fact, be constructed.

b. By applying measurements of relevant parameters associated with lake degradation, the generalized model can be transformed into an operational representation of a lake, its drainage basin and related nutrients.

c. With such a transformation, an assessment of the potential for eutrophication control can be made.

LAKE ANALYSIS

This report documents the first stage of evaluation of lake and watershed data collected from the study lake and its drainage basin. It is formatted to provide state environmental agencies with specific information for basin planning [§303(e)], water quality criteria/ standards review [§303(c)], clean lakes [§314(a,b)], and water quality monitoring [§106 and §305(b)] activities mandated by the Federal Water Pollution Control Act Amendments of 1972.

Beyond the single lake analysis, broader based correlations between nutrient concentrations (and loading) and trophic condition are being made to advance the rationale and data base for refinement of nutrient water quality criteria for the Nation's fresh water lakes. Likewise, multivariate evaluations of the relationships between land use, nutrient export and trophic condition, by lake class or use, are being developed to assist in the formulation of planning guidelines and policies by EPA and to augment plans implementation by the states.

ACKNOWLEDGMENT

The staff of the National Eutrophication Survey (Office of Research & Development, U. S. Environmental Protection Agency) expresses sincere appreciation to the Maine Department of Environmental Protection for professional involvement and to the Maine National Guard for conduct of the tributary sampling phase of the Survey.

William R. Adams, Commissioner of the Department of Environmental Protection, and William P. Hinckley and Matthew Scott of the Division of Lakes and Biological Studies, provided invaluable lake documentation and counsel during the course of the study.

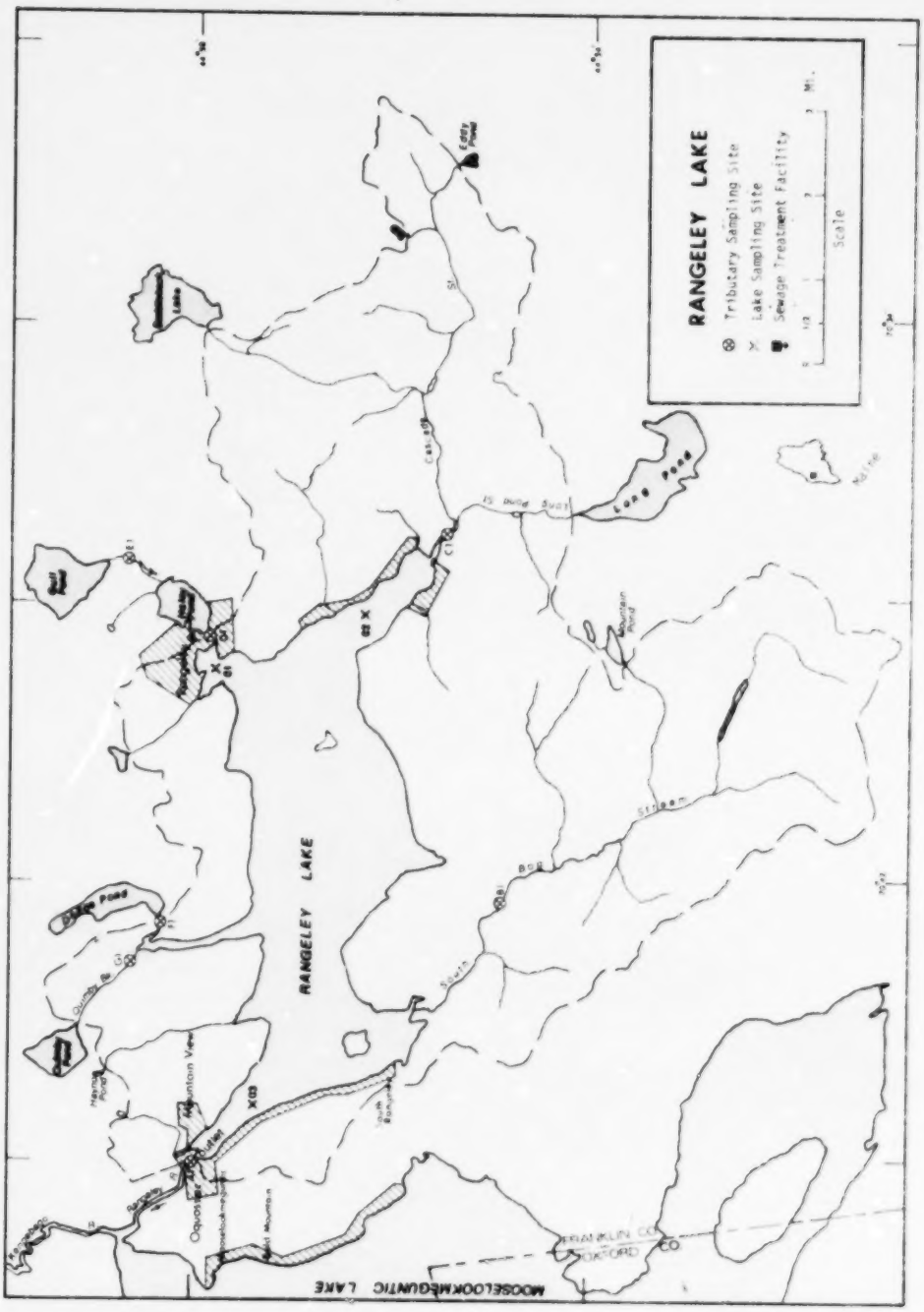
Major General Edwin W. Heywood (Retired), then the Adjutant General of Maine, and Project Officer Lieutenant Colonel Earl B. Adams who directed the volunteer efforts of the forty-one participating Maine National Guardsmen are also gratefully acknowledged for their assistance to the Survey.

NATIONAL EUTROPHICATION SURVEY

STUDY LAKES

STATE OF MAINE

LAKE NAME	COUNTY
Moosehead Lake	Piscataquis, Somerset
Estes Lake	York
Long Lake	Cumberland
Bay of Naples & Sebago Lake	Cumberland
Rangeley Lake	Franklin
Long Lake	Aroostook
Mattawamkeag Lake	Aroostook
Sebasticook Lake	Penobscot


RANGELEY LAKE
Tributary Sampling Site
Lake Sampling Site
Sewage Treatment Facility
Scale
Mi.
RANGELEY LAKE
MOOSELOOKMEGUNTIC LAKE
Stream
Mountain Road
Haines Road
Dodge Pond
Cascade
Rt. 16
Rt. 17
Rt. 4
Rt. 5
Rangeley
Oquossoc
Franklin Co.
Oxford Co.

RANGELEY LAKE

STORET NO. 2310

I. CONCLUSIONS

A. Trophic Condition:

Survey data indicate that Rangeley Lake is oligotrophic. Agency personnel of the State of Maine also consider the lake to be oligotrophic on the basis of their more extensive data.

B. Rate-Limiting Nutrient:

Algal assay results and lake data show that Rangeley Lake was phosphorus limited when sampled.

C. Nutrient Controllability:

During the sampling year, about 78% of the total phosphorus load to Rangeley Lake was contributed by non-point or areal sources, while the community of Rangeley was contributing about 15%, and camp and home septic tanks around the lake were estimated to have contributed about 7%.

Construction of 95% phosphorus removal facilities at Rangeley is scheduled in 1974. This degree of treatment should help preserve the present excellent quality of Rangeley Lake.

At present, septic tank contributions may not be a problem. However, as lakeshore development progresses to meet increasing recreational needs, consideration should be given to the control of these sources to further protect the lake.

II. INTRODUCTION

Rangeley Lake has been famous for its cold-water game fishery since the middle of the nineteenth century. Fishing pressure on the lake is presently heavy and increasing, with salmon and trout predominant in the catch.

In addition to fishing, the lake is highly valued for swimming, boating, scenic enjoyment, and storage of water for hydroelectric power generation (the Union Water Power Company, Lisbon, controls about 11% of the volume by means of a small dam at the outlet). The watershed is mostly forested; and until the early 1950's, the lake was utilized periodically for log-driving operations.

The region is now undergoing rapid development for outdoor recreational purposes with steady growth in both permanent (presently about 1,500) and seasonal population (presently peaking at about 13,000). Much of the shoreline of the lake is developed with camps and homes. Most of these are served by septic tanks, although reportedly the soil does not provide adequate absorption of tank effluents. While the lake receives no industrial discharges, it does receive secondary effluent from the Rangeley wastewater treatment plant via Haley Pond, and a nutrient load of unknown magnitude is contributed directly by Rangeley storm sewers.

The Rangeley plant became operational in the fall of 1970; and reportedly algal blooms in Haley Pond have occurred since then. At times, large plumes of algae reach City Cove of Rangeley Lake via the pond outlet and reduce the aesthetic quality of that portion of the lake.

III. LAKE AND DRAINAGE BASIN CHARACTERISTICS

A. Lake Morphometry:

1. Surface area: 6,000 acres.
2. Mean depth: 47 feet.
3. Maximum depth: 149 feet.
4. Volume: 282,000 acre/feet.
5. Mean hydraulic retention time: 2.8 years.

B. Tributary and Outlet:
(See Appendix A for flow data)

1. Tributaries -

Name	Drainage area†	Mean flow†
South Bog Stream	15.4 mi^2	24.6 cfs
Long Pond Stream	21.0 mi^2	34.2 cfs
Haley Pond Outlet	9.8 mi^2	13.3 cfs
Dodge Pond Outlet	18.1 mi^2	27.0 cfs
Quimby Brook	1.6 mi^2	1.9 cfs
Minor tributaries & immediate drainage -	23.7 mi^2	36.3 cfs
Totals	89.6 mi^2	137.3 cfs

2. Outlet -

Rangeley River	99.0 mi^2*	137.3 cfs*

C. Precipitation**:

1. Year of sampling: 38.4 inches.
2. Mean annual: 40.0 inches.

---

* Includes area of lake; outflow adjusted to equal sum of inflows.
** See Working Paper No. 1, "Survey Methods".
† Drainage areas are accurate within ±1% and mean annual flows within ±5%.

IV. LAKE WATER QUALITY SUMMARY

Rangeley Lake was sampled three times during the open-water season of 1972 by means of a pontoon-equipped Huey helicopter. Each time, samples for physical and chemical parameters were collected from three stations on the lake and from a number of depths at each station (see map, page v). During each visit a single depth-integrated (15 feet or near bottom to surface) sample was composited from the three stations for phytoplankton identification and enumeration; and during the last visit, a single five-gallon depth-integrated sample was composited for algal assays. Also each time, a depth-integrated sample was collected from each of the stations for chlorophyll a analysis. Maximum depths sampled were 14 feet at station 1, 64 feet at station 2, and 20 feet at station 3.

It should be noted that the Survey Secchi disc values are consistently less than those observed by the Maine Department of Environmental Protection. Such variations could be attributed to fluctuations in cloud cover or sun angle (ambient light conditions), observer technique, water surface disturbance, or may, in fact, be the result of short-term water clarity differences.

The results obtained are presented in full in Appendix B, and the data for the fall sampling period, when the lake was essentially well-mixed, are summarized below. Note, however, the Secchi disc summary is based on all values.

For differences in the various parameters at the other sampling times, refer to Appendix B.

A. Physical and chemical characteristics:

FALL VALUES

(10/02/72)

Parameter	Minimum	Mean	Median	Maximum
Temperature (Cent.)	8.6	13.2	13.7	14.0
Dissolved oxygen (mg/l)	7.2	8.6	9.0	9.4
Conductivity (μmhos)	50	94	105	105
pH (units)	6.4	6.7	6.7	6.8
Alkalinity (mg/l)	10	13	13	18
Total P (mg/l)	0.006	0.008	0.007	0.011
Dissolved P (mg/l)	0.005	0.007	0.006	0.011
$NO_2 + NO_3$ (mg/l)	0.060	0.074	0.070	0.140
Ammonia (mg/l)	0.020	0.037	0.040	0.060

ALL SAMPLES

Secchi disc (inches)	120	148	153	180

B. Biological characteristics:

1. Phytoplankton* -

Sampling Date	Dominant Genera	Number per ml
10/02/72	1. Dinobryon	632
	2. Flagellates	557
	3. Fragilaria	346
	4. Polycystis	331
	5. Achnanthes	271
	Other genera	1,236
	Total	3,373

* The June and August phytoplankton samples were lost in transit.

2. Chlorophyll a -
(Because of instrumentation problems during the 1972 sampling, the following values may be in error by plus or minus 20 percent.)

Sampling Date	Station Number	Chlorophyll a (µg/l)
06/08/72	01	6.1
	02	0.8
	03	3.5
08/07/72	01	2.7
	02	1.7
	03	1.9
10/02/72	01	1.7
	02	1.7
	03	1.8

C. Limiting Nutrient Study:

1. Autoclaved, filtered, and nutrient spiked -

Spike (mg/l)	Ortho P Conc. (mg/l)	Inorganic Conc. (mg/l)	Maximum yield (mg/l-dry wt.)
Control	0.012	0.115	0.4
0.006 P	0.018	0.115	2.7
0.012 P	0.024	0.115	2.4
0.024 P	0.036	0.115	2.6
0.060 P	0.072	0.115	2.4
0.060 P + 10.0 N	0.072	10.115	10.2
10.0 N	0.012	10.115	0.3

2. Discussion -

The control yield of the assay alga, Selenastrum capricornutum, indicates that the potential primary productivity of Rangeley Lake was relatively low at the time the sample was collected. Also, the increased yield resulting from the first orthophosphorus spike shows that Rangeley Lake was phosphorus limited. At ortho-P concentrations higher than about 0.018 mg/l, however, yields do not change significantly until

nitrogen is also added which indicates the lake would become nitrogen limited if ortho-P concentrations in the lake were increased to about 0.018 mg/l. Note that the addition of only nitrogen produced a yield not significantly different than the control yield.

Lake data indicate that Rangeley Lake was phosphorus limited at the other sampling times as well. Nitrogen to phosphorus ratios were 69 to 1 and 20 to 1 in June and August, respectively (phosphorus limitation would be expected with N/P ratios of 14 to 1 or greater).

D. Trophic Condition:

Survey data indicate that Rangeley Lake is oligotrophic, and personnel of the Maine Department of Environmental Protection classify the lake as oligotrophic on the basis of their more extensive sampling. Nutrient concentrations were very low, and Secchi disc transparencies were exceptional.

Generally, chlorophyll a levels were quite low. However, at station 1 in City Cove, which receives the Haley Pond overflow, two of the three samples had chlorophyll levels higher than would be expected. It is believed these higher chlorophyll levels resulted from the overflows of Haley Pond. Reportedly, green plumes of algae-laden water from Haley Pond occur frequently in City Cove.

In all other parameters measured, Rangeley Lake is quite comparable to oligotrophic Moosehead and Sebago lakes.

V. NUTRIENT LOADINGS*
(See Appendix B for data)

For the determination of nutrient loadings, from September, 1972, through August, 1973, the Maine National Guard collected monthly near-surface grab samples from the tributary sites indicated on the map (page v), except for the high runoff months of April and May, when two samples per month were collected. Stream flow estimates were provided by the Maine District Office of the U.S. Geological Survey through an interagency agreement.

Discharges from the Rangeley wastewater treatment plant were sampled by the operator on a monthly basis and flow data were provided. The phosphorus load reported for the plant was adjusted for partial retention in Haley Pond into which the effluent is discharged (see discussion, pages 12 and 13).

In this report, tributary nutrient loads were calculated with mean concentrations and mean flows. The loads for unsampled "minor tributaries and immediate drainage" ("ZZ" of U.S.G.S.) were calculated with mean ZZ flows and mean South Bog Stream concentrations at station B-1.

Note that though the Gull Pond outlet stream was sampled at station E-1, there are no flow data for that site, and nutrient loads could not be calculated.

---

* Based on sampling frequency and variations in concentrations, single tributary loadings for gaged sites are believed to be within ±16% of the true value 67% of the time and within ±32% of the true value 95% of the time.

A. Waste Sources:
(See Appendix C for all data)

1. Municipal -

Name	Pop. Served	Treatment	Mean Flow (mgd)	Receiving Water
Rangeley	900	Act. sludge	0.071	Haley Pond

2. Industrial - None known

B. Annual Total Phosphorus Loading - Average Year:

1. Inputs -

Source	lbs P/ yr	% of total
a. Tributaries (non-point load) -		
South Bog Stream	480	10.0
Long Pond Stream	740	15.6
Haley Pond outlet	240	5.0
Dodge Pond outlet	580	12.1
Quimby Brook	30	0.6
b. Minor tributaries & immediate drainage (non-point load)* -	720	15.1
c. Municipal STP's -		
Rangeley	730	15.3
d. Septic tanks** -	320	6.7
e. Industrial -		
None known	-	-
f. Direct precipitation* -	940	19.6
Total	4,780	100.0

2. Outputs -

Lake outlet 2,430

3. Net annual P accumulation - 2,350 lbs.

* Estimated; see Working Paper No. 1, "Survey Methods".
** Estimate based on 504 lakeside residences and camps.

C. Annual Total Nitrogen Loading - Average Year:

1. Inputs -

Source	lbs N/ yr	% of total
a. Tributaries (non-point load) -		
South Bog Stream	28,910	13.6
Long Pond Stream	29,890	14.0
Haley Pond outlet	19,380	9.1
Dodge Pond outlet	21,900	10.3
Quimby Brook	2,150	1.0
b. Minor tributaries & immediate drainage (non-point load)* -	38,950	18.3
c. Municipal STP's -		
Rangeley	2,300	1.1
d. Septic tanks** -	11,840	5.6
e. Industrial -		
None known	-	-
f. Direct precipitation* -	57,800	27.0
Total	213,120	100.0

2. Outputs -

Lake outlet 116,500

3. Net annual N accumulation - 96,620 lbs.

* Estimated; see Working Paper No. 1, "Survey Methods".
** Estimate based on 504 lakeside residences and camps.

D. Mean Annual Non-point Nutrient Export by Sub-drainage Area:

Tributary	lbs P/mi^2/yr	lbs N/mi^2/yr
South Bog Stream	31	1,877
Long Pond Stream	35	1,423
Haley Pond outlet	24	1,978
Dodge Pond outlet	32	1,210
Quimby Brook	19	1,344

E. Yearly Loading Rates:

In the following table, the existing phosphorus loading rates are compared to those proposed by Vollenweider (1973). Essentially, his "dangerous" rate is the rate at which the receiving waters would become eutrophic or remain eutrophic; his "permissible" rate is that which would result in the receiving water remaining oligotrophic or becoming oligotrophic if morphometry permitted. A mesotrophic rate would be considered one between "dangerous" and "permissible".

	Total Phosphorus		Total Nitrogen	
Units	Total	Accumulated	Total	Accumulated
lbs/acre/yr	0.8	0.4	35.1	15.5
grams/m^2/yr	0.09	0.04	3.93	1.74

Vollenweider loading rates for phosphorus ($g/m^2/yr$) based on the mean depth and mean hydraulic retention time of Rangeley Lake:

"Dangerous" (eutrophic rate)	0.44
"Permissible" (oligotrophic rate)	0.22

F. Controllability of Nutrients:

1. Discussion -

During the sampling year, Rangeley Lake received a total phosphorus load at a rate less than half that proposed by Vollenweider as permissible (i.e., an oligotrophic rate). About 78% of the load was contributed by non-point or areal sources, and the community of Rangeley contributed about 15% via Haley Pond. It is estimated that camp and home septic tanks around the lake contributed about 7%.

Since the Rangeley waste treatment plant discharges effluent to Haley Pond, some portion of the total phosphorus load from the plant would be expected to be sedimented and/or biologically assimilated in the Pond. To determine what proportion of the total load probably reached Rangeley Lake, the following rationale was applied.

It is calculated that 870 lbs. of phosphorus were discharged from the treatment plant during the sampling year. Areal contributions to Haley Pond were estimated by deriving the mean annual P-load, in $lbs/mi^2/yr$, from all of the other tributaries sampled and multiplying this mean value by the drainage area of Haley Pond (in mi^2). Areal contributions thus determined were 290 lbs/yr.

The sum of point-source and areal contributions to the Pond, then, totaled 1,160 lbs. However, during the sampling year,

only 970 lbs were measured leaving Haley Pond at station D-1, or 84% of that contributed by all sources. Therefore, the phosphorus loads attributed to the Haley Pond outlet and the Rangeley treatment plant (see phosphorus loading, page 9) are values adjusted for the 16% of these loads estimated to have remained in Haley Pond.

The phosphorus removal facilities to be added to the Rangeley waste treatment plant should help preserve the existing excellent quality of Rangeley Lake. The planned 95% phosphorus removal will result in about a 71% reduction of phosphorus loading to 170-acre Haley Pond as well as a significant reduction in the localized loading rate to City Cove of Rangeley Lake. Furthermore, the improvement in trophic condition of Haley Pond should reduce the occurrence of algal blooms there and the resulting aesthetically unpleasant green plumes of algae in City Cove.

At present, septic tank contributions may not be a problem. However, because the soils in the area prevent effective absorption of tank effluents, and because shoreline developments are expected to increase, consideration should be given to future control of these nutrient sources to further protect the quality of Rangeley Lake.

VI. LITERATURE REVIEWED

Anonymous, 1953. Rangeley Lake survey report. Dept. of Inland Fisheries and Game, Augusta.

Grove, William, 1973. Personal communication (control and uses of Rangeley Lake water). Union Water Power Co., Lisbon.

Guevremont, Gerome J., 1973. Personal communication (algae in Haley Pond water, sewage treatment facilities, population, and land use in watershed). Wastewater Treatment Plant, Rangeley.

Hinckley, William P., 1973. Personal communication (Rangeley waste treatment facilities; drainage basin characteristics). Dept. of Environmental Protection, Augusta.

Miller, Ronald, 1973. Personal communication (present and anticipated development in watershed; watershed population and land use). City of Rangeley.

Scott, Matthew, 1973. Personal communication (trophic condition of Rangeley Lake, shoreline development survey, and morphometry of lake). Dept. of Environmental Protection, Augusta.

Vollenweider, Richard A., 1973. Input-output models. MS, Canada Centre for Inland Lakes, Burlington, Ontario.

VII. APPENDICES

APPENDIX A

TRIBUTARY FLOW DATA

TRIBUTARY FLOW INFORMATION FOR MAINE 6/25/74

LAKE CODE 2310 RANGELEY LAKE

TOTAL DRAINAGE AREA OF LAKE 99.00

TRIBUTARY	SUB-DRAINAGE AREA	NORMALIZED FLOWS JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
2310A1	99.00	144.00	97.00	127.00	154.00	187.00	129.00	54.00	75.00	185.00	224.00	121.00	160.00	138.32
2310B1	15.40	8.80	8.10	12.00	82.00	70.00	21.00	11.00	9.00	9.70	16.00	27.00	20.00	24.57
2310C1	21.00	19.00	15.00	26.00	96.00	109.00	33.00	14.00	11.00	11.00	18.00	31.00	26.00	34.15
2310D1	9.79	7.20	6.30	11.00	42.00	36.00	11.00	5.00	4.20	3.90	6.40	14.00	13.00	13.34
2310F1	18.10	12.00	10.00	16.00	85.00	80.00	24.00	12.00	9.80	9.30	15.00	28.00	23.00	27.04
2310G1	1.55	1.40	1.50	4.00	6.20	3.30	1.00	0.34	0.29	0.33	0.54	2.00	1.70	1.88
2310Z1	33.10	25.00	28.00	60.00	117.00	74.00	27.00	9.00	6.50	7.20	11.00	38.00	33.00	36.26

SUMMARY

TOTAL DRAINAGE AREA OF LAKE = 99.00
SUM OF SUB-DRAINAGE AREAS = 98.94

TOTAL FLOW IN = 1646.00
TOTAL FLOW OUT = 1657.00

MEAN MONTHLY FLOWS AND DAILY FLOWS

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
2310A1	9	72	634.00	16	471.00				
	10	72	427.00	14	410.00				
	11	72	288.00	4	243.00				
	12	72	272.00	2	408.00				
	1	73	255.00	6	160.00				
	2	73	272.00	3	647.00				
	3	73	335.00	2	46.00				
	4	73	105.00	7	24.00	21	132.00		
	5	73	626.00	6	422.00	19	740.00		
	6	73	220.00	2	328.00				
	7	73	406.00	14	257.00				
	8	73	273.00	11	354.00				
2310A1	9	72	23.00	16	14.00				
	10	72	20.00	14	19.00				
	11	72	52.00	4	42.00				
	12	72	34.00	2	51.00				
	1	73	16.00	6	10.00				
	2	73	26.00	3	58.00				
	3	73	35.00	2	7.40				
	4	73	46.00	7	71.00	21	91.00		
	5	73	170.00	6	82.00	19	142.00		
	6	73	42.00	2	62.00				
	7	73	70.00	14	38.00				
	8	73	48.00	11	46.00				

TRIBUTARY FLOW INFORMATION FOR MAINE 6/25/74

LAKE CODE 2310 HANGELEY LAKE

MEAN MONTHLY FLOWS AND DAILY FLOWS

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
2310C1	9	72	26.00	16	16.00				
	10	72	22.00	14	21.00				
	11	72	60.00	4	49.00				
	12	72	44.00	2	66.00				
	1	73	35.00	6	22.00				
	2	73	47.00	3	104.00				
	3	73	75.00	2	16.00				
	4	73	101.00	7	83.00	21	107.00		
	5	73	186.00	6	126.00	19	219.00		
	6	73	65.00	2	96.00				
	7	73	49.00	14	48.00				
	8	73	59.00	11	81.00				
2310D1	9	72	9.30	16	5.90				
	10	72	8.00	14	7.50				
	11	72	27.00	4	22.00				
	12	72	22.00	2	33.00				
	1	73	13.00	6	8.30				
	2	73	20.00	3	44.00				
	3	73	32.00	2	6.70				
	4	73	44.00	7	36.00	21	47.00		
	5	73	62.00	6	42.00	19	73.00		
	6	73	22.00	2	32.00				
	7	73	32.00	14	17.00				
	8	73	23.00	11	32.00				
2310F1	9	72	22.00	16	14.00				
	10	72	19.00	14	18.00				
	11	72	54.00	4	44.00				
	12	72	39.00	2	58.00				
	1	73	22.00	6	14.00				
	2	73	32.00	3	71.00				
	3	73	46.00	2	9.70				
	4	73	89.00	7	73.00	21	94.00		
	5	73	137.00	6	93.00	19	142.00		
	6	73	48.00	2	71.00				
	7	73	76.00	14	41.00				
	8	73	53.00	11	73.00				
2310G1	9	72	0.79	16	0.50				
	10	72	0.68	14	0.64				
	11	72	3.90	4	3.20				
	12	72	2.90	2	4.40				
	1	73	2.60	6	1.70				
	2	73	4.70	3	10.00				
	3	73	12.00	2	2.50				
	4	73	6.50	7	5.30	21	6.90		
	5	73	5.60	6	3.80	19	6.60		
	6	73	2.00	2	2.90				
	7	73	2.20	14	1.20				
	8	73	1.60	11	2.20				

TRIBUTARY FLOW INFORMATION FOR MAINE 6/25/74

LAKE CODE 2310 RANGELEY LAKE

MEAN MONTHLY FLOWS AND DAILY FLOWS

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
231077	9	72	17.00						
	10	72	14.00						
	11	72	74.00						
	12	72	56.00						
	1	73	46.00						
	2	73	88.00						
	3	73	173.00						
	4	73	123.00						
	5	73	127.00						
	6	73	53.00						
	7	73	57.00						
	8	73	35.00						

APPENDIX B

PHYSICAL and CHEMICAL DATA

K - Value is less than indicated
J - Value known to be in error

STORET RETRIEVAL DATE 74/06/25

231001
44 58 00.0 070 39 00.0
RANGELEY LAKE
23 MAINE

11EPALES 2111202
5 0010 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3-N TOTAL MG/L	00665 PHOS-TOT MG/L P	00666 PHOS-DIS MG/L P
72/06/08	10 40	0000	12.6	10.6	120	20	6.90	10K	0.080	0.020	0.006	0.003
	10 40	0010	11.0	10.8		20	6.80	10K	0.100	0.040	0.004	0.002
72/08/07	08 20	0000			129	50K	6.80	10K	0.070	0.050	0.008	0.005
	08 20	0004	20.1	9.0		50K	6.70	10K	0.060	0.040	0.007	0.005
	08 20	0010	20.1	8.8		50K	6.80	10K	0.060	0.040	0.007	0.007
	08 20	0014	20.0	8.8		50K	6.70	10K	0.070	0.070	0.008	0.006
72/10/02	16 45	0000			156	50K	6.60	13	0.070	0.050	0.011	0.007
	16 45	0004	13.7	9.4		50K	6.80	13	0.060	0.030	0.006	0.005
	16 45	0009	13.7	8.4		85	6.80	14	0.060	0.040	0.008	0.007

DATE FROM TO	TIME OF DAY	DEPTH FEET	32217? CHLRPHYL A UG/L
72/06/08	10 40	0000	6.1J
72/08/07	08 20	0000	2.7J
72/10/02	16 45	0000	1.7J

STORET RETRIEVAL DATE 74/06/25

231002
44 56 00.0 070 38 00.0
RANGELEY LAKE
23 MAINE

11EPALES
5

2111202
0033 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3-N TOTAL MG/L	00665 PHOS-TOT MG/L P	00666 PHOS-DIS MG/L P
72/06/08	10	55 0000	12.0	11.5	144	20	6.80	10K	0.110	0.070	0.004	0.002
	10	55 0005	12.1	11.5		20	6.80	10K	0.100	0.020	0.002	0.002
	10	55 0010	11.8	11.4								
	10	55 0015	11.6	11.4		20	6.90	10K	0.100	0.020	0.004	0.004
	10	55 0020	11.6	11.5								
	10	55 0025	11.5	11.4		20	6.90	10K	0.120	0.030	0.005	0.002K
	10	55 0030	10.2									
	10	55 0033	5.3	11.6		20	6.50	10K	0.130	0.060	0.002	0.002
72/08/07	08	50 0000				50K	6.60	10K	0.070	0.070	0.005	0.005
	08	50 0004	19.9	8.8		50K	6.60	10K	0.060	0.050	0.006	0.005
	08	50 0010	19.9	11.0		50K	6.60	10K	0.060	0.050	0.007	0.004
	08	50 0014	19.9	8.0		50K	6.60	10K	0.060	0.030	0.005	0.004
72/10/02	17	00 0000				90	6.80	18	0.070	0.040	0.009	0.009
	17	00 0004	14.0	9.0		90	6.70	16	0.070	0.040	0.010	0.009
	17	00 0015	13.7	9.0		100	6.70	16	0.060	0.030	0.006	0.006
	17	00 0025	13.7	9.0		105	6.80	14	0.070	0.040	0.006	0.006
	17	00 0035	13.6	9.0		105	6.80	14	0.070	0.040	0.006	0.006
	17	00 0045	13.5	9.0		105	6.80	10K	0.060	0.060	0.006	0.005
	17	00 0055	13.0	7.2		105	6.80	10K	0.120	0.030	0.007	0.005
	17	00 0064	8.6	7.2		105	6.40	10K	0.140	0.020	0.009	0.005

DATE FROM TO	TIME OF DAY	DEPTH FEET	32217 CHLRPHYL A UG/L
72/06/08	10	55 0000	0.8J
72/08/07	08	50 0000	1.7J
72/10/02	17	00 0000	1.7J

STORET RETRIEVAL DATE 74/06/25

231003
44 57 24.0 070 45 24.0
RANGELEY LAKE
23 MAINE

11EPALES 2111202
3 0012 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3-N TOTAL MG/L	00665 PHOS-TOT MG/L P	00666 PHOS-DIS MG/L P
72/06/08	11 45	0000	11.1	11.6	156	20	6.80	10K	0.100	0.020	0.003	0.002
	11 45	0005	9.8	11.8								
	11 45	0009	7.8	11.7		20	6.80	10K	0.110	0.010K	0.012	0.003
72/08/07	08 00	0000			153	50K	6.70	10K	0.070	0.050	0.007	0.006
	08 00	0004	19.0	9.0		50K	6.70	10K	0.030	0.010K	0.005	0.006
	08 00	0009	18.9	9.0		50K	6.60	10K	0.030	0.010K	0.008	0.005
72/10/02	16 20	0000			180	105	6.70	16	0.070	0.050	0.011	0.011
	16 20	0004	14.0	8.7		105	6.70	13	0.070	0.040	0.007	0.006
	16 20	0015	13.4	9.2		105	6.70	12	0.060	0.030	0.008	0.005
	16 20	0020	13.4	7.9		105	6.70	11	0.060	0.020	0.007	0.006

DATE FROM TO	TIME OF DAY	DEPTH FEET	32217 CHLRPHYL A UG/L
72/06/08	11 45	0000	3.5J
72/08/07	08 00	0000	1.9J
72/10/02	16 20	0000	1.8J

APPENDIX C

TRIBUTARY and WASTEWATER TREATMENT PLANT DATA

K - Value is less than indicated
J - Value known to be in error

STORET RETRIEVAL DATE 74/06/25

2310A1 LS2310A1
44 58 00.0 070 46 30.0
RANGELEY RIVER
23 15 OQUOSSOC
O/RANGELEY LAKE
ST HWY 4 BRDG E OF OQUOSSOC
11FPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
72/09/16	13 40		0.063	0.400	0.048	0.005K	0.008
72/10/14	11 45		0.094	0.200	0.050	0.005K	0.007
72/12/02	11 20		0.056	0.200	0.008	0.005K	0.007
73/01/06	11 35		0.078	0.460	0.015	0.005K	0.005K
73/02/03	12 50		0.088	0.250	0.035	0.005K	0.010
73/03/02	12 00		0.105	0.140	0.028	0.005K	0.005K
73/04/07	10 00		0.105	0.220	0.023	0.005K	0.015
73/04/21	09 00		0.080	0.190	0.005K	0.005K	0.020
73/05/19	13 10		0.084	0.910	0.013	0.005K	0.005K
73/06/02	11 10		0.088	0.460	0.012	0.006	0.010
73/07/14	11 00		0.075	0.600	0.198	0.005K	0.005K
73/08/11	10 55		0.010K	0.235	0.021	0.010	0.015

STORET RETRIEVAL DATE 74/06/25

231081 LS231081
44 58 00.0 070 42 30.0
SOUTH BOG STREAM
23 15 RANGELEY
T/RANGELEY LAKE
OFF ST HWY 17 2 MI SE OF S RANGELEY
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
72/09/16	13 50		0.084	0.200	0.046	0.005K	0.007
72/10/14	12 00		0.050	0.250	0.063	0.005K	0.010
72/11/04	12 30		0.156	0.370	0.028	0.005K	0.011
72/12/02	11 40		0.170	0.540	0.014	0.005K	0.008
73/01/06	11 50		0.220	0.830	0.024	0.005K	0.005K
73/02/03	13 00		0.270	0.400	0.026	0.006	0.015
73/03/02			0.250	0.120	0.019	0.005K	0.005K
73/04/07	10 00		0.252	0.230	0.017	0.005K	0.010
73/04/21	09 10		0.210	0.210	0.008	0.005K	0.010
73/05/06	10 10		0.120	1.150	0.080	0.005K	
73/05/19			0.082	1.000	0.014	0.005K	0.015
73/06/02	11 20		0.042	0.210	0.008	0.006	0.010
73/07/14	11 00		0.048	0.420	0.025	0.005K	0.005K
73/08/11	10 40		0.067	0.310	0.014	0.005K	0.020

STORET RETRIEVAL DATE 74/06/25

2310C1 LS2310C1
44 55 30.0 070 37 00.0
LONG POND STREAM
23 15 RANGELEY
T/RANGELEY LAKE
BRDG AT SE CORNER OF GREENVALE COVE
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
72/09/16	14 10		0.096	0.300	0.088	0.005K	0.017
72/10/14	12 15		0.116	0.350	0.115	0.005K	0.011
72/11/04	12 45		0.120	0.190	0.030	0.005K	0.007
72/12/02	12 00		0.090	0.200	0.013	0.005K	0.007
73/02/03	13 10		0.270	0.220	0.044	0.006	0.010
73/04/07	10 10		0.189	0.150	0.008	0.005K	0.005K
73/04/21	09 20		0.138	0.200	0.015	0.005K	0.015
73/05/19			0.091	0.890	0.009	0.005K	0.005K
73/06/02	11 30		0.063	0.240	0.011	0.006	0.010
73/07/14	11 00		0.060	0.420	0.098	0.005K	0.005K
73/08/11	10 30		0.054	0.440	0.026	0.005K	0.030

STORET RETRIEVAL DATE 74/06/25

2310D1 LS2310D1
44 58 00.0 070 38 30.0
UNNAMED OUTLET OF HALEY POND
23 15 RANGELEY
T/RANGELEY LAKE
ST HWY 4 BRDG IN RANGELEY
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
72/09/16	12 45		0.104	0.550	0.063	0.014	0.046
72/10/14	11 15		0.135	1.250	0.138	0.005K	0.030
72/11/04	11 45		0.208	1.080	0.138	0.010	0.070
72/12/02	12 10		0.154	0.880	0.140	0.007	0.029
73/01/06	12 50		0.200	0.660	0.132	0.016	0.024
73/02/03	13 30		0.340	0.380	0.154	0.029	0.050
73/03/02			0.380	0.670	0.150	0.040	0.060
73/04/07	10 20		0.231	0.540	0.042	0.008	0.025
73/04/21	09 30		0.168	0.270	0.013	0.005K	0.025
73/05/19	12 00		0.038	1.000	0.010	0.005K	0.030
73/06/02	11 40		0.010K	0.310	0.005K	0.007	0.030
73/07/14	11 00		0.013	0.560	0.037	0.005K	0.025
73/08/11	11 20		0.010K	0.630	0.071	0.005	0.040

STORET RETRIEVAL DATE 74/06/25

2310E1 LS2310E1
44 58 30.0 070 37 30.0
OUTLET OF GULL TO HALEY POND
23 15 RANGELEY
T/RANGELEY LAKE
ST HWY 16 BRDG NE OF RANGELEY
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
72/09/16	13 00		0.054	0.200	0.063	0.005K	0.007
72/10/14	11 25		0.078	0.650	0.072	0.005K	0.007
72/11/04	12 00		0.084	0.670	0.086	0.005K	0.009
72/12/02	12 20		0.013	0.230	0.011	0.005K	0.008
73/01/06	13 00		0.035	0.310	0.018	0.005K	0.006
73/02/03	13 20		0.086	0.320	0.018	0.017	
73/03/02	12 00		0.096	0.310	0.022	0.006	0.010
73/04/07	10 30		0.126	0.230	0.015	0.005K	0.005K
73/04/21	09 30		0.069	0.500	0.012	0.005K	0.025
73/05/06	10 00		0.072	0.780	0.050	0.005K	0.005K
73/05/19	12 30		0.034	0.750	0.026	0.005K	0.005K
73/06/02	11 50		0.015	0.345	0.019	0.006	0.015
73/07/14	11 00		0.029		0.132	0.005K	0.005K
73/08/11	12 00		0.010K	0.280	0.016	0.005K	0.015

STORET RETRIEVAL DATE 74/06/25

2310F1 LS2310F1
44 58 30.0 070 42 30.0
UNNAMED OUTLET OF DODGE POND
23 15 RANGELEY
T/RANGELEY LAKE
ST HWYS 4/16 BRDG W OF RANGELEY
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
72/09/16	13 15		0.052	4.100	0.060	0.005K	0.019
72/10/14	11 35		0.086	0.250	0.060	0.005K	0.010
72/12/02	11 00		0.060	0.360	0.017	0.005K	0.011
73/01/06	11 15		0.120	0.310	0.021	0.005K	0.005K
73/02/03	12 30		0.220	0.250	0.010	0.009	0.009
73/03/02	12 00		0.250	0.230	0.015	0.005K	0.015
73/04/07	10 30		0.189	0.460	0.015	0.005K	0.005K
73/04/21	08 45		0.160	0.210	0.007	0.005K	0.005K
73/05/06	10 40		0.140		0.094	0.005K	0.010
73/05/19	12 30		0.084	0.310	0.010	0.005K	0.005K
73/06/02	12 00		0.052	0.200	0.005K	0.006	0.040
73/07/14	11 00		0.010K	0.420	0.018	0.005K	0.005K
73/08/11	11 15		0.010K	0.300	0.016	0.005K	0.015

STORET RETRIEVAL DATE 74/06/25

2310G1 LS2310G1
44 58 30.0 070 43 30.0
QUIMBY BROOK
23 15 RANGELEY
T/RANGELEY LAKE
ST HWYS 4/16 BRDG W OF RANGELEY
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
72/09/16	13 30		0.195		0.072	0.006	0.010
72/10/14	11 45		0.156	0.150	0.060	0.005K	0.007
72/12/02	11 10		0.180	0.300	0.011	0.005K	0.011
73/01/06	11 25		0.170	0.260	0.015	0.005K	0.005K
73/02/03	12 45		0.280	0.320	0.025	0.006	0.006
73/03/02	12 00		0.240	0.260	0.056	0.005K	0.005K
73/04/07	10 40		0.315	0.340	0.017	0.005K	0.005K
73/04/21	08 00		0.270	0.180	0.006	0.005K	0.010
73/05/06	10 30		0.132	0.360	0.033	0.005K	0.005K
73/05/19	12 30		0.096	0.920	0.033	0.005K	0.005K
73/06/02	12 10		0.097	0.980	0.032	0.005K	0.005K
73/07/14	11 00		0.120	0.310	0.011	0.005K	0.005K
73/08/11	11 00		0.094	0.360	0.015	0.005K	0.020

STORET RETRIEVAL DATE 74/06/25

231050 AS231050 P000900
44 58 30.0 070 38 00.0
RANGELEY
23 15 RANGELEY
T/RANGELEY LAKE
HALEY POND
11EPALES 2141204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P	50051 FLOW RATE INST MGD	50053 CONDUIT FLOW-MGD MONTHLY
73/01/16	09 00								
CP(T)-			7.300	4.700	2.950	3.400	3.900	0.062	0.062
73/01/17	09 00								
73/02/05	09 00								
CP(T)-			4.500	3.700	2.400	1.680	1.950	0.085	0.077
73/02/06	09 00								
73/03/05	09 00								
CP(T)-			12.600	6.200	2.300	3.975	4.900	0.071	0.080
73/03/06	09 00								
73/04/18	07 00								
CP(T)-			3.100	1.500	0.130	2.200	2.500	0.095	0.110
73/04/19	07 00								
73/05/16	07 00								
CP(T)-			7.600	1.000	0.140	3.200	3.450	0.067	0.098
73/05/17	07 00								
73/06/19	07 00								
CP(T)-			0.210	1.500	0.251	2.300	2.600	0.083	0.082
73/06/20	07 00								
73/07/23	07 00								
CP(T)-			18.400	0.660	0.200	6.537	6.556	0.053	0.085
73/07/24	07 00								
73/08/29	07 00								
CP(T)-				1.800		6.100	6.400	0.051	0.070
73/08/30	06 00								
73/09/13	07 00								
CP(T)-			11.200		0.180	4.900	5.000	0.039	0.056
73/09/14	07 00								
73/10/18	07 00								
CP(T)-			13.400	3.630	0.110	3.625	3.630	0.037	0.046
73/10/19	06 00								
73/11/19	07 00								
CP(T)-			11.000	1.050	0.110	2.400	2.600	0.057	0.045
73/11/20	07 00								
73/12/28	17 00								
CP(T)-			2.200	25.000	5.900	2.100	3.750	0.059	0.054
73/12/29	16 00								

STORET RETRIEVAL DATE 74/06/25

231050 AS231050 P000900
44 58 30.0 070 38 00.0
RANGELEY
23 15 RANGELEY
T/RANGELEY LAKE
HALEY POND
11EPALES
4 2141204
0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P	50051 FLOW RATE INST MGD	50053 CONDUIT FLOW-MGD MONTHLY
74/01/21	07 00								
CP(T)-			9.500	4.500	1.680	3.300	3.800	0.038	0.063
74/01/22	07 00								
74/02/11	07 00								
CP(T)-			5.000	1.600	0.150	3.400	3.750	0.037	0.047
74/02/12	07 00								
74/03/11	07 00								
CP(T)-			5.400	2.700	0.480	3.000	3.800	0.047	0.041
74/03/12	07 00								
74/04/22	07 00								
CP(T)-			1.520	2.200	0.330	1.800	2.500	0.077	0.054
74/04/23	07 00								
74/05/22	07 00								
CP(T)-			6.300	2.950	0.067	1.850	2.200	0.030	0.064
74/05/23	06 00								